Canadian Grain Commission
Commission canadienne des grains

Grain Research Laboratory

Quality of Western Canadian Wheat 1989

Canada

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Summary

More normal growing conditions in 1989 resulted in yields well over those of drought-plagued 1988 and about equal to the average of the ten years preceding last year. Total wheat production this year was somewhat over the ten-year average, with durum wheat production being the second-highest on record. Red winter wheat production was well below average due to severe winter-kill and reduced seeded area.

Protein content is again higher than normal but not quite as high as in 1988. Hard red spring wheat averages 14.5% and amber durum wheat 14.7%.

Untimely rains during September delayed harvesting and caused considerable weathering and sprout damage in swathed grain. Most of the top grade wheat was taken off before the rains and will be adequately protected by the grading system. Lower grades of all classes, however, will contain some sprouted kernels and cargoes during the coming crop year will show lower than normal Falling Number values.

Milling and baking performance is generally good, although water absorption is lower than normal. The quality of spaghetti made from amber durum wheat is very good.

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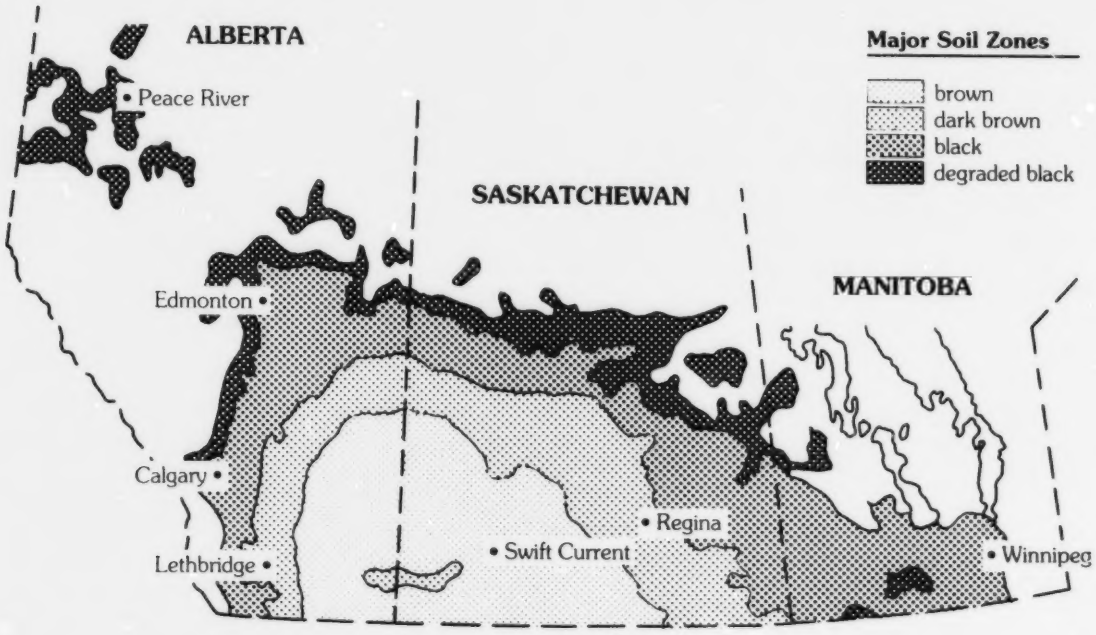
Figure 1. Map of Western Canada Showing Major Soil Zones in the Wheat Producing Areas



Introduction

This bulletin presents detailed information on the quality of the 1989 crop of four classes of Canadian wheat offered on the world market:

Canada Western Red Spring Wheat: a hard wheat with superior milling and baking quality. It is offered at various guaranteed levels of protein content.

Canada Western Amber Durum Wheat: a durum wheat producing a high yield of semolina with excellent pasta-making quality.

Canada Western Red Winter Wheat: a hard wheat suitable for the production of a wide variety of products including French breads, flat breads, steamed breads and certain types of noodles.

Canada Western Soft White Spring Wheat: soft wheat of medium-to-low protein content for production of various types of flat breads, noodles, steamed breads, chapattis, cookies, cakes and pastry.

It is important to note that data presented in this bulletin are not quality specifications for Canadian wheat. Rather, they represent the best estimate we can obtain in time for the Grain Research Laboratory to report at the end of October to the Committee on Western Grain Standards.

The extent to which the data in this bulletin indicate the exact quality characteristics of wheat of any given grade that will be exported during the coming year depends on a number of factors. These include: the amounts and relative quality of carryover stocks of each grade, and whether the harvest survey composites are, indeed, truly representative of the harvest production, both on a geographic basis and in terms of harvest progress, from the earliest harvested samples to the latest.

The average quality of carlot unloads and, hence, of cargoes of any given grade may be slightly lower than that indicated by our harvest survey. In particular, falling number values of lower grades tend to be lower and more variable for export cargoes following a wet harvest - such as was encountered this year.

After a relatively dry year in 1987, severe drought in 1988 and a dry 1988/89 winter for much of the Prairies, seeding conditions for the 1989 crop were below average. Crop prospects improved considerably with good rainfall distribution in June, but a hot, dry July led to deteriorating conditions during grain filling. Rain from late August into September, particularly in Alberta and much of Saskatchewan, interrupted the harvest for several weeks and resulted in significant weathering and sprout damage in wheat laying in the swath. Indeed, whereas a high proportion of hard red spring wheat and durum wheat harvested before the rain qualified for the top (No. 1 Canada Western) grades, most of the late harvest will be of lower grade. The red winter wheat crop was seriously damaged during a sudden freeze in southern Alberta; consequently, about 50% of this acreage was ploughed down.

Data from the 1989 protein content survey and from tests on grade composite samples of the four classes of wheat are presented in the series of tables, figures and comments which now follow. Details regarding the collection of samples and methods used to obtain the data are provided at the end of this bulletin.

1: Protein Content of 1989 and 1988 Crop Canadian Wheat Classes (Preliminary as at October 20, 1989)

Class	1989 - Preliminary	1988 - Final
	Protein Content*	Protein Content*
	%	%
Canada Western Red Spring	14.5	14.8
Canada Western Amber Durum	14.7	15.6
Canada Western Red Winter	11.3	12.7
Canada Western Soft White Spring	11.0	11.1

* mean value (all grades), N x 5.7; 13.5% moisture content basis.

Canada Western Red Spring Wheat

Statistics Canada *(Field Crop Reporting Series*, No. 7, October 4, 1989) estimates 1989 production at 18.4 million tonnes from 10.5 million seeded hectares, compared with the final estimate of 12.4 million tonnes from 10.1 seeded hectares in the drought year of 1988 and the ten-year (1978-87) average value of 19.7 million tonnes from 10.4 seeded hectares.

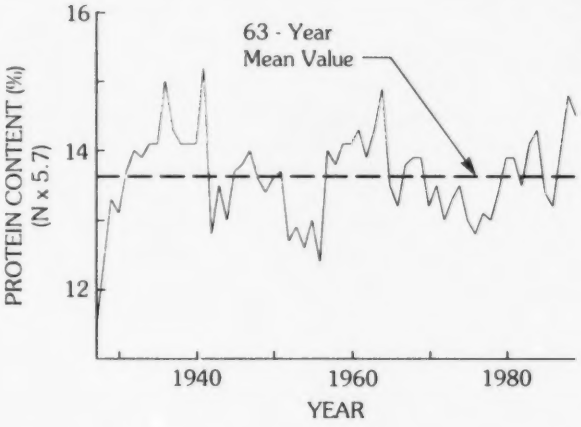
Variety distribution (from *Prairie Grain Variety Survey 1989*, Prairie Pools Inc., Regina) of Canada Western Red Spring (CWRS) wheat for 1989 is: Katepwa - 51%; Neepawa - 19%; Columbus - 17%; Conway, Park and Laura - 2% each; others - 7%.

Protein Survey

The average protein content of the 1989 red spring wheat crop is currently estimated at 14.5% - down 0.3 percentage units from 1988 but 0.3 percentage units over the ten-year average for 1979-88. This mean protein content estimate is based on 18,744 harvest survey samples tested to October 20, 1989. Annual fluctuation in mean protein content since 1927 is given in Figure 2. Table 2 shows mean protein content distributions by province and grade and ten-year means (1979-88) by grade.

Milling grades of this year's crop show a normal drop in protein content with grade from No. 1 CWRS (14.9%) to No. 3 CWRS (14.0%). This drop is most pronounced for the province of Alberta which, while lowest in protein overall (14.2% vs 14.5% for Manitoba and Saskatchewan), has the highest protein No. 1 CWRS (15.3%) and the lowest protein No. 3 CWRS (13.6%).

Figure 2: Mean Protein Content of Harvest Survey Western Canadian Red Spring Wheat 1927 to 1989



2: Protein Content of 1989 Harvest Survey Red Spring Wheat (Preliminary as at October 20, 1989)

	Protein Content (%)*					
	Western Canada			1989		
Grade	1989	1988	1979-88	Manitoba	Saskatchewan	Alberta
No. 1 CWRS	14.9	14.9	14.4	14.8	14.9	15.3
No. 2 CWRS	14.5	14.8	14.2	14.3	14.7	14.2
No. 3 CWRS	14.0	14.8	13.9	13.8	14.1	13.6
CW Feed	14.8	15.5	14.1	14.5	14.9	14.5
All Grades	**14.5**	**14.8**	**14.2**	**14.5**	**14.5**	**14.2**

* N x 5.7; 13.5% moisture content basis.

Milling and Baking Quality Data

For quality assessment of the 1989 Canada Western Red Spring (CWRS) wheat crop, composites were prepared from over 18,000 harvest survey samples representing the three milling grades. These composites are divided by region into Eastern and Western Prairie, with each region representing grain which is normally exported through Atlantic and Pacific ports, respectively. The No. 1 and No. 2 grades are further segregated by protein content with minimum levels of 12.5%, 13.5% and 14.5% (13.5% moisture basis).

No. 1 Canada Western Red Spring Wheat

Quality data for the No. 1 CWRS composites are given in Tables 3 to 6. Test weight and kernel weight are lower than normal. All composites show low levels of alpha-amylase activity and correspondingly high values for wheat falling number and flour amylograph peak viscosity.

Flour yield values for both Eastern and Western Prairie composites are similar to those in 1988. Flour ash content values for the Eastern Prairie composites are higher than the ten-year averages, while flour color is superior.

Farinograph absorptions are lower than normal for the top two grades. Dough strength properties, such as farinograph dough development time and extensigraph area, are within the range normally expected for top grade CWRS wheat flour

Baking results for this year's No. 1 grade show high loaf volume per unit of flour protein and very good crumb and crust characteristics. Baking absorption is, however, lower than in recent years. The oxidation requirement of this year's crop appears to be similar to that of 1988.

Additional pilot milling information for No. 1 CWRS wheat is presented on pages 12 and 13.

No. 2 Canada Western Red Spring Wheat

Quality characteristics are shown in Tables 9 and 10. Wheat falling number and flour amylograph peak viscosity values are lower than those of 1988. Because the effect of wet weather conditions during the later harvest period may not be fully reflected in the composites, values for these parameters are likely to be considerably lower in 1989-90 export shipments than is indicated by our harvest survey.

Flour yield is similar to last year for Eastern Prairie composites and higher for Western Prairie composites. Flour color values, as in 1988, show superior values for both regions.

Physical dough properties are within the range normally expected for high grade CWRS wheat flour.

Baking results are very good with high loaf volume per unit protein content and high scores for crumb and crust characteristics. Absorption is lower than normal.

No. 3 Canada Western Red Spring Wheat

Tables 11 and 12 provide quality data for No. 3 CWRS Eastern and Western Prairie composites. Wheat and flour protein content are lower than in 1988 but are still much higher than long term averages. Test weight is similar to last year but lower than ten-year average values. Both composites show elevated levels of alpha-amylase activity and correspondingly low values for wheat falling number and flour amylograph peak viscosity. Falling number values for 1989-90 export shipments of No. 3 grade wheat are likely to be even lower than indicated by these data.

The overall milling quality appears superior to that of previous years. Both composites show higher flour yield and lower flour ash values than long term averages and higher flour yield compared with 1988 results.

Stronger dough properties (longer farinograph dough development time and larger extensigraph area) are evident when compared with long term averages. Both composites show good baking performance associated with the high protein content.

3: NO. 1 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1989 Eastern Prairie Harvest Survey Grade Composite Samples

Quality Parameter	Minimum Protein Level			No. 1 CW 13.5	
	14.5	13.5	12.5	1988	Mean*
WHEAT					
Test Weight, kg/hL	80.7	80.6	81.1	81.2	81.3
Weight per 1000 Kernels, g	27.6	28.6	28.8	29.7	30.2
Protein Content, % (N x 5.7)	14.8	14.0	12.9	14.1	13.7
Ash Content, %	1.61	1.57	1.53	1.49	1.60
Alpha-amylase Activity, units/g	3.7	3.6	3.4	3.1	3.5
Falling Number, s	400	410	390	405	400
MILLING					
Flour Yield					
Clean Wheat Basis, %	74.0	74.0	74.6	74.3	75.4
0.50% Ash Basis, %	75.0	74.5	74.6	76.8	76.9
-0.3 Flour Color Grade Basis, %	74.9	75.5	76.7	76.1	76.3
FLOUR					
Protein Content, %	13.9	13.1	12.3	13.3	13.2
Wet Gluten Content, %	41.2	40.1	36.2	40.3	39.2
Ash Content, %	0.48	0.49	0.50	0.45	0.47
Color, units	-0.6	-0.8	-1.0	-0.9	-0.6
Starch Damage, Farrand units	30	32	32	33	31
Alpha-amylase Activity, units/g	0.9	1.4	0.8	0.8	0.8
Amylograph Peak Viscosity, BU	760	705	730	775	725
Maltose Value, g/100 g	1.9	2.0	2.1	2.0	2.0
BAKING (Remix Method)					
Absorption, %	65	64	62	65	65
Loaf Volume, cm^3	950	850	800	895	870
Appearance	8.5	8.2	8.0	8.5	8.2
Crumb Structure	6.8-o	7.0-o	7.0-o	6.8-o	6.8-o
Crumb Color	6.0-d	5.8-d	5.5-d	6.0-d	6.0-d
Blend Loaf Volume, cm^3	720	710	675	740	710
FARINOGRAM					
Absorption, %	64.2	63.8	63.2	64.6	64.8
Development Time, min.	4.75	4.25	3.75	4.75	4.50
Mixing Tolerance Index, BU	20	25	30	20	30
Stability, min.	11.50	9.00	7.50	10.50	8.00
EXTENSIGRAM					
Length, cm	22	22	21	22	22
Height at 5 cm, BU	295	290	300	290	260
Maximum Height, BU	490	490	480	500	420
Area, cm^2	145	145	135	150	130
ALVEOGRAM					
Length, mm	152	141	115	135	116
P (height x 1.1), mm	90	96	106	100	98
W, x 10^3 ergs	432	433	412	438	373

* mean values are for the 10-year period 1978 to 1987.

4: NO. 1 CANADA WESTERN RED SPRING WHEAT
Supplementary Baking Data • 1989 Eastern Prairie Harvest Survey Grade Composite Samples

Quality Parameter	Minimum Protein Level			1988
	14.5	13.5	12.5	No. 1 CW 13.5
SPONGE-AND-DOUGH METHOD				
Potassium Bromate, ppm	20	20	20	20
Absorption, %	67	65	64	66
Mixing*: energy, Whr/kg	4.1	4.0	4.1	3.7
Mixing*: time, min,	4.8	4.7	5.0	3.6
Loaf Volume, cm^3/100 g flour	1 190	1 120	1 048	1 060
Yield: bread wt./flour wt.	1.44	1.43	1.42	1.44
Appearance	8.9	8.3	7.5	7.8
Crumb Structure	6.8-o+	6.8-o	6.8-o	6.8-o
Crumb Color	8.1	8.2	7.8	8.2
CANADIAN SHORT PROCESS				
Ascorbic Acid/Bromate, ppm	37.5/30	37.5/30	37.5/30	37.5/30
Absorption, %	68	67	66	69
Mixing*: energy, Whr/kg	7.1	8.1	7.5	7.8
Mixing*: time, min.	7.0	7.8	7.9	6.5
Loaf Volume, cm^3/100 g flour	1 158	1 073	1 030	1 128
Yield: bread wt./flour wt.	1.54	1.53	1.52	1.54
Appearance	8.9	7.9	7.7	8.2
Crumb Structure	6.8-o	6.7-o	6.8-o	6.8-o
Crumb Color	8.5	8.0	7.8	8.5

* dough stage

5: NO. 1 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1989 Western Prairie Harvest Survey Grade Composite Samples

Quality Parameter	Minimum Protein Level			No. 1 CW 13.5	
	14.5	13.5	12.5	1988	Mean*
WHEAT					
Test Weight, kg/hL	79.6	80.6	81.1	80.9	81.7
Weight per 1000 Kernels, g	28.4	28.8	29.4	31.4	30.5
Protein Content, % (N x 5.7)	14.8	13.9	12.9	14.0	13.7
Ash Content, %	1.52	1.52	1.48	1.51	1.54
Alpha-amylase Activity, units/g	3.7	3.4	4.0	4.4	4.0
Falling Number, s	410	410	395	395	385
MILLING					
Flour Yield					
Clean Wheat Basis, %	75.2	75.3	74.8	74.6	75.4
0.50% Ash Basis, %	76.7	76.8	75.3	76.1	76.9
-0.3 Flour Color Grade Basis, %	76.1	76.8	76.9	77.0	76.3
FLOUR					
Protein Content, %	14.4	13.2	12.4	13.2	13.2
Wet Gluten Content, %	43.7	39.4	35.2	41.6	38.8
Ash Content, %	0.47	0.47	0.49	0.47	0.47
Color, units	-0.6	-0.8	-1.0	-1.1	-0.6
Starch Damage, Farrand units	29	31	32	32	32
Alpha-amylase Activity, units/g	1.1	1.1	1.2	1.3	1.1
Amylograph Peak Viscosity, BU	735	745	675	715	670
Maltose Value, g/100 g	1.8	1.9	2.0	2.1	2.1
BAKING (Remix Method)					
Absorption, %	65	64	62	66	64
Loaf Volume, cm^3	980	890	815	875	870
Appearance	8.5	8.2	8.2	8.0	8.0
Crumb Structure	6.8-o	6.8-o	7.0-o	7.0-o	6.8-o
Crumb Color	6.5-d	6.0-d	5.5-d	6.5-d	6.0-d
Blend Loaf Volume, cm^3	735	720	690	740	715
FARINOGRAM					
Absorption, %	65.1	63.9	63.8	66.9	65.2
Development Time, min.	5.25	4.75	4.50	4.75	4.75
Mixing Tolerance Index, BU	25	25	30	30	30
Stability, min.	13.00	11.00	9.50	8.00	8.00
EXTENSIGRAM					
Length, cm	23	22	21	22	22
Height at 5 cm, BU	280	290	295	245	265
Maximum Height, BU	485	485	490	405	430
Area, cm^2	145	145	135	125	130
ALVEOGRAM					
Length, mm	147	135	112	112	115
P (height x 1.1), mm	88	95	107	105	100
W, x 10^3 ergs	406	418	403	383	385

* mean values are for the 10-year period 1978 to 1987.

6: NO. 1 CANADA WESTERN RED SPRING WHEAT
Supplementary Baking Data • 1989 Western Prairie Harvest Survey Grade Composite Samples

Quality Parameter	Minimum Protein Level			1988
	14.5	13.5	12.5	No. 1 CW 13.5
SPONGE-AND-DOUGH METHOD				
Potassium Bromate, ppm	20	20	20	20
Absorption, %	66	65	65	68
Mixing*: energy, Whr/kg	3.8	3.9	3.5	3.5
Mixing*: time, min,	4.3	4.6	4.9	3.3
Loaf Volume, cm^3/100 g flour	1 203	1 133	1 100	1 058
Yield: bread wt./flour wt.	1.44	1.43	1.43	1.45
Appearance	8.7	8.3	8.0	7.7
Crumb Structure	6.8-o	6.8-o	6.8-o	6.8-o
Crumb Color	8.4	8.1	7.8	7.9
CANADIAN SHORT PROCESS				
Ascorbic Acid/Bromate, ppm	37.5/30	37.5/30	37.5/30	37.5/30
Absorption, %	68	67	67	70
Mixing*: energy, Whr/kg	7.5	8.9	7.1	7.7
Mixing*: time, min.	7.3	8.6	7.7	6.2
Loaf Volume, cm^3/100 g flour	1 150	1 090	1 023	1 093
Yield: bread wt./flour wt.	1.54	1.53	1.53	1.55
Appearance	8.1	8.1	7.7	8.2
Crumb Structure	6.8-o	6.8-o	6.7-o	6.8-o
Crumb Color	8.2	8.0	7.8	8.2

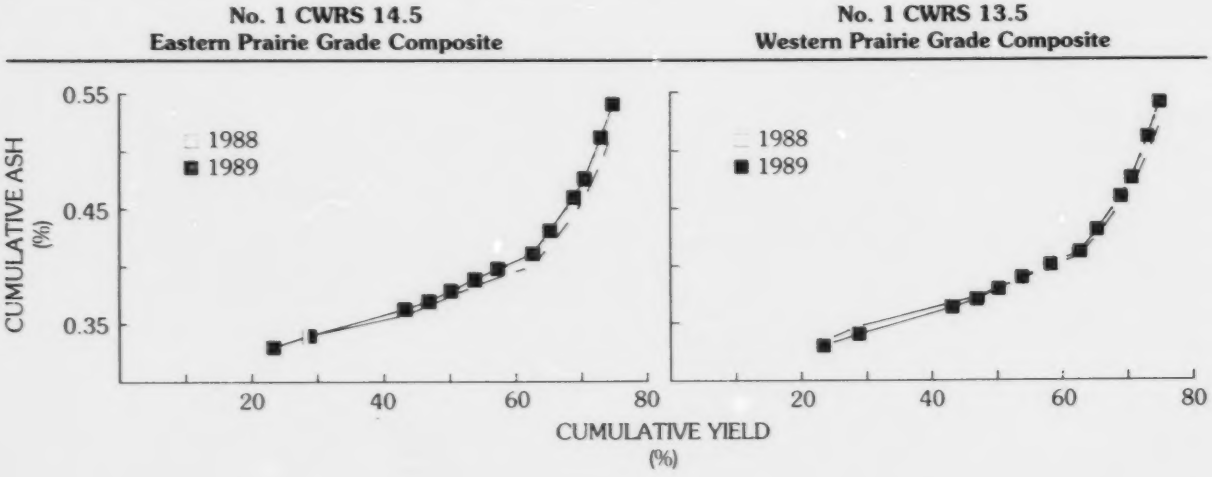
* dough stage

GRL Pilot Mill Data

Samples of 1988 and 1989 harvest survey Eastern Prairie No. 1 CWRS 14.5 and Western Prairie No. 1 CWRS 13.5 were milled consecutively with the GRL Pilot Mill to obtain additional data to complement laboratory-scale testing. Cumulative ash curves (Figure 3) were computed from the ash content of individual millstreams from each milling. A straight-grade flour and a high quality patent flour were both prepared to allow comparison of flour properties at two extraction rates (Tables 7 and 8).

The 1989 crop composites gave a slightly greater flour yield than the 1988 composites. Cumulative ash curves showed that the 1989 crop had a tendency to higher ash content than the 1988 crop, particularly at high extraction. The two crops exhibited comparable flour grade color.

Figure 3: Cumulative Ash Curves for Pilot Millings



7: NO. 1 CANADA WESTERN 14.5 RED SPRING WHEAT
Pilot Mill Flour Data • 1989 Eastern Prairie Harvest Survey Grade Composite Samples

	GRL Pilot Mill Straight-grade Flour		GRL Pilot Mill Patent Flour	
Quality Parameter	1989	1988	1989	1988
FLOUR				
Flour Yield, %	74.8	74.5	45.0	45.0
Protein Content, %	14.3	14.3	13.1	13.0
Wet Gluten Content, %	42.4	44.4	39.0	40.6
Ash Content, %	0.54	0.51	0.37	0.36
Color, units	1.0	1.2	-2.1	-1.8
Starch Damage, Farrand units	26	26	26	28
FARINOGRAM				
Absorption, %	64.2	64.8	62.7	64.1
Development Time, min.	4.25	4.75	5.00	6.50
Mixing Tolerance Index, BU	30	25	15	10
Stability, min.	8.50	9.50	30.50	27.50

8: NO. 1 CANADA WESTERN 13.5 RED SPRING WHEAT
Pilot Mill Flour Data • 1989 Western Prairie Harvest Survey Grade Composite Samples

	GRL Pilot Mill Straight-grade Flour		GRL Pilot Mill Patent Flour	
Quality Parameter	1989	1988	1989	1988
FLOUR				
Flour Yield, %	74.9	75.2	45.0	45.0
Protein Content, %	13.3	13.5	12.3	12.4
Wet Gluten Content, %	38.9	43.4	36.9	39.3
Ash Content, %	0.54	0.52	0.36	0.36
Color, units	0.7	0.8	-2.3	-2.3
Starch Damage, Farrand units	30	32	30	32
FARINOGRAM				
Absorption, %	63.0	65.9	62.0	65.0
Development Time, min.	4.50	4.25	5.75	4.50
Mixing Tolerance Index, BU	35	35	10	15
Stability, min.	9.00	8.00	37.00	19.50

9: NO. 2 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1989 Eastern Prairie Harvest Survey Grade Composite Samples

	Minimum Protein Level			No. 2 CW 13.5	
Quality Parameter	14.5	13.5	12.5	1988	Mean*
WHEAT					
Test Weight, kg/hL	77.7	78.1	78.7	79.2	80.0
Weight per 1000 Kernels, g	29.0	29.6	30.0	30.9	31.1
Protein Content, % (N x 5.7)	14.7	13.8	12.9	14.1	13.7
Ash Content, %	1.60	1.54	1.56	1.53	1.61
Alpha-amylase Activity, units/g	14.8	11.7	7.9	6.1	5.2
Falling Number, s	350	355	370	375	390
MILLING					
Flour Yield					
Clean Wheat Basis, %	74.8	75.2	74.5	73.8	75.0
0.50% Ash Basis, %	76.3	76.2	75.5	76.8	76.0
-0.3 Flour Color Grade Basis, %	75.1	76.7	76.9	75.6	75.0
FLOUR					
Protein Content, %	13.8	13.1	12.2	13.2	13.1
Wet Gluten Content, %	41.7	39.9	36.0	39.4	38.8
Ash Content, %	0.47	0.48	0.48	0.44	0.48
Color, units	-0.4	-0.8	-1.1	-0.9	-0.3
Starch Damage, Farrand units	27	28	29	27	28
Alpha-amylase Activity, units/g	3.1	2.8	2.7	2.8	1.7
Amylograph Peak Viscosity, BU	465	555	570	590	625
Maltose Value, g/100 g	1.8	1.8	2.0	1.8	2.0
BAKING (Remix Method)					
Absorption, %	66	64	63	64	64
Loaf Volume, cm^3	935	870	805	910	870
Appearance	8.5	8.2	8.0	8.5	8.0
Crumb Structure	6.8-o	7.0-o	7.0-o	6.8-o	6.8-o
Crumb Color	6.2-d	6.0-d	5.5-d	6.8-d	6.2-d
Blend Loaf Volume, cm^3	730	715	680	730	705
FARINOGRAM					
Absorption, %	64.2	63.4	62.9	63.8	64.5
Development Time, min.	4.50	4.50	3.75	4.75	4.50
Mixing Tolerance Index, BU	25	30	35	30	35
Stability, min.	10.50	9.00	8.00	9.00	7.75
EXTENSIGRAM					
Length, cm	23	21	22	22	22
Height at 5 cm, BU	280	295	290	300	255
Maximum Height, BU	440	495	460	520	395
Area, cm^2	135	140	135	155	125
ALVEOGRAM					
Length, mm	145	131	120	154	111
P (height x 1.1), mm	86	91	103	88	94
W, x 10^3 ergs	379	381	402	425	351

* mean values are for the 10-year period 1978 to 1987.

10: NO. 2 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1989 Western Prairie Harvest Survey Grade Composite Samples

Quality Parameter	Minimum Protein Level			No. 2 CW 13.5	
	14.5	13.5	12.5	1988	Mean*
WHEAT					
Test Weight, kg/hL	78.5	79.1	79.6	79.3	80.2
Weight per 1000 Kernels, g	30.6	31.3	31.6	30.8	31.3
Protein Content, % (N x 5.7)	14.7	13.7	12.9	14.0	13.7
Ash Content, %	1.46	1.49	1.55	1.59	1.54
Alpha-amylase Activity, units/g	13.9	19.4	14.2	7.5	6.3
Falling Number, s	325	325	330	370	365
MILLING					
Flour Yield					
Clean Wheat Basis, %	75.7	75.3	75.5	74.0	75.0
0.50% Ash Basis, %	77.7	76.8	76.5	75.5	76.0
-0.3 Flour Color Grade Basis, %	76.3	76.8	77.6	75.8	74.7
FLOUR					
Protein Content, %	14.2	13.0	12.1	13.4	13.1
Wet Gluten Content, %	42.2	37.6	34.6	41.8	38.7
Ash Content, %	0.46	0.47	0.48	0.47	0.48
Color, units	-0.5	-0.8	-1.0	-0.9	-0.2
Starch Damage, Farrand units	28	31	32	30	31
Alpha-amylase Activity, units/g	9.8	6.4	5.5	2.8	2.4
Amylograph Peak Viscosity, BU	270	315	315	570	520
Maltose Value, g/100 g	2.2	2.2	2.3	2.2	2.1
BAKING (Remix Method)					
Absorption, %	65	64	62	66	65
Loaf Volume, cm^3	960	870	810	915	865
Appearance	8.5	8.2	8.0	8.2	8.0
Crumb Structure	6.5-o	6.8-o	7.0-o	6.8-o	6.8-o
Crumb Color	6.5-d	6.0-d	5.5-d	6.8-d	6.0-d
Blend Loaf Volume, cm^3	745	720	675	720	705
FARINOGRAM					
Absorption, %	64.5	63.8	63.0	66.3	65.3
Development Time, min.	5.25	4.50	3.75	5.25	4.50
Mixing Tolerance Index, BU	30	35	40	30	30
Stability, min.	8.00	7.50	7.00	8.50	7.50
EXTENSIGRAM					
Length, cm	24	23	22	21	22
Height at 5 cm, BU	280	290	265	275	245
Maximum Height, BU	510	465	425	455	375
Area, cm^2	160	150	130	130	115
ALVEOGRAM					
Length, mm	172	134	125	123	111
P (height x 1.1), mm	86	93	100	100	97
W, x 10^3 ergs	439	400	392	384	349

* mean values are for the 10-year period 1978 to 1987.

11: NO. 3 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1989 Eastern Prairie Harvest Survey Grade Composite Samples

Quality Parameter	1989	1988	Mean*
WHEAT			
Test Weight, kg/hL	77.6	77.6	78.3
Weight per 1000 Kernels, g	29.2	31.3	30.7
Protein Content, % (N x 5.7)	14.2	15.3	13.3
Ash Content, %	1.49	1.49	1.62
Alpha-amylase Activity, units/g	60.9	53.7	16.5
Falling Number, s	230	240	330
MILLING			
Flour Yield			
Clean Wheat Basis, %	75.4	74.0	74.3
0.50% Ash Basis, %	76.9	76.0	74.8
-0.3 Flour Color Grade Basis, %	73.6	72.2	72.8
FLOUR			
Protein Content, %	13.3	14.5	12.7
Wet Gluten Content, %	38.9	44.7	36.9
Ash Content, %	0.47	0.46	0.49
Color, units	0.3	0.3	0.2
Starch Damage, Farrand units	30	26	29
Alpha-amylase Activity, units/g	32.6	17.2	5.0
Amylograph Peak Viscosity, BU	85	135	320
Maltose Value, g/100 g	3.1	2.5	2.4
BAKING (Remix Method)			
Absorption, %	63	65	63
Loaf Volume, cm^3	915	990	845
Appearance	8.5	8.5	7.8
Crumb Structure	6.5-o	6.5-o	6.8-o
Crumb Color	6.0-d	6.8-d	6.0-d
Blend Loaf Volume, cm^3	730	750	690
FARINOGRAM			
Absorption, %	63.7	65.1	64.2
Development Time, min.	3.75	4.50	4.00
Mixing Tolerance Index, BU	45	30	35
Stability, min.	6.50	7.50	6.50
EXTENSIGRAM			
Length, cm	23	25	22
Height at 5 cm, BU	250	235	250
Maximum Height, BU	415	415	385
Area, cm^2	130	140	120
ALVEOGRAM			
Length, mm	140	160	105
P (height x 1.1), mm	89	82	100
W, x 10^3 ergs	382	402	359

* mean values are for the 10-year period 1978 to 1987.

12: NO. 3 CANADA WESTERN RED SPRING WHEAT
Quality Data for 1989 Western Prairie Harvest Survey Grade Composite Samples

Quality Parameter	1989	1988	Mean*
WHEAT			
Test Weight, kg/hL	78.5	78.0	79.1
Weight per 1000 Kernels, g	30.4	30.8	31.6
Protein Content, % (N x 5.7)	13.9	14.6	13.1
Ash Content, %	1.56	1.65	1.58
Alpha-amylase Activity, units/g	93.2	42.8	23.8
Falling Number, s	195	255	290
MILLING			
Flour Yield			
Clean Wheat Basis, %	75.6	73.7	74.6
0.50% Ash Basis, %	76.6	74.2	74.6
-0.3 Flour Color Grade Basis, %	73.5	71.6	73.1
FLOUR			
Protein Content, %	13.2	13.9	12.3
Wet Gluten Content, %	38.8	44.1	36.1
Ash Content, %	0.48	0.49	0.50
Color, units	0.4	0.4	0.2
Starch Damage, Farrand units	28	29	32
Alpha-amylase Activity, units/g	43.9	17.8	7.8
Amylograph Peak Viscosity, BU	80	110	250
Maltose Value, g/100 g	3.5	2.9	2.7
BAKING (Remix Method)			
Absorption, %	63	65	63
Loaf Volume, cm^3	900	905	795
Appearance	8.5	8.2	7.5
Crumb Structure	6.8-o	6.8-o	6.5-o
Crumb Color	5.8-d	6.2-d	5.2-dy
Blend Loaf Volume, cm^3	700	715	675
FARINOGRAM			
Absorption, %	64.5	65.8	64.9
Development Time, min.	4.00	4.50	3.75
Mixing Tolerance Index, BU	55	35	45
Stability, min.	6.50	7.00	6.25
EXTENSIGRAM			
Length, cm	25	24	21
Height at 5 cm, BU	230	235	240
Maximum Height, BU	410	430	350
Area, cm^2	140	140	105
ALVEOGRAM			
Length, mm	142	126	96
P (height x 1.1), mm	86	93	106
W, x 10^3 ergs	365	379	347

* mean values are for the 10-year period 1978 to 1987.

Canada Western Amber Durum Wheat

As in 1985 and 1986, untimely rains in September interrupted harvest of the amber durum wheat crop so that early-harvested wheat qualified for the top grades while later-harvested material was degraded due to sprout damage, mildew and frost. The level of sprout damage is reflected in the falling number values. Protein content is again high but lower (0.9 percentage units) than that in 1988. Spaghetti color and cooking quality are very good.

The estimated production of durum wheat in 1989 is 3.99 million tonnes (Statistics Canada, *Field Crop Reporting Series*, No. 7, October 4, 1989), second only to the record 4.01 million tonnes in 1987. It is twice the 1988 production and well above the ten-year average of 2.65 million tonnes (1979-1988). A record area of 2.62 million hectares was seeded to durum wheat this year. Yield (1.52 tonnes/hectare) was much better than the 0.87 tonnes/hectare in 1988 but a little below the ten-year average of 1.60 tonnes/hectare.

The predominant variety this year was again Kyle (*Prairie Grain Variety Survey 1989*, Prairie Pools Inc., Regina), accounting for 42.3% of the area seeded to durum whet. Wakooma was second at 18.1%, followed by Medora (13.3%), Wascana (12.1%) and Sceptre (7.6%). Figure 5 shows the changing varietal pattern in the past decade. Compared with the early 1980's, the percentage of weak gluten varieties like Wascana (those with low SDS sedimentation values) has decreased significantly from 33% to 12%.

A total of 3 033 individual samples were used to make up the grade composite samples. The average protein content of 14.7% is almost one percentage unit lower than that of 1988. The falling number values are low for the lower grades but the overall quality of all grades is very good. Semolina yield is higher in all grades compared with 1988 values. Both semolina color and speck count in the lower grades are significantly better than last year. Spaghetti quality in terms of color and cooking quality are very good. Surface stickiness values are higher than in 1988.

Tables 14 and 15 provide complete quality data for grade composite samples of the 1989 crop.

Figure 4: Mean Protein Content of Harvest Survey Western Canadian Amber Durum Wheat 1963 to 1989

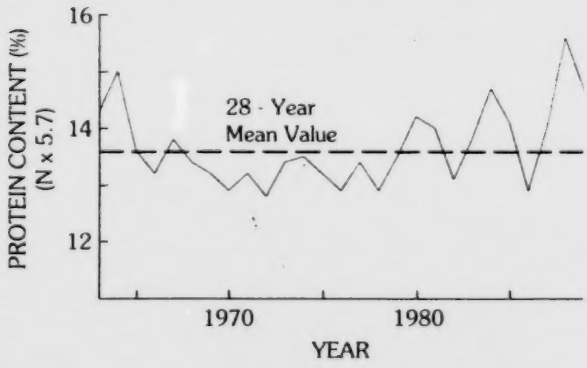
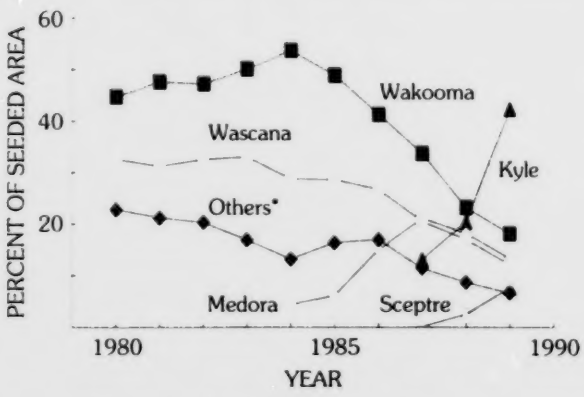


Figure 5: Annual Distribution of Amber Durum Wheat Varieties Grown in Western Canada



* Others: Arcola, Coulter, Macoun, Hercules, Pelissier.

13: Protein Content of 1989 Harvest Survey Canada Western Amber Durum Wheat

Grade	Protein Content (%)*					
	Western Canada			1989		
	1989	1988	1981-88	Manitoba	Saskatchewan	Alberta
No. 1 CWAD	15.1	15.5	14.1	15.9	15.0	15.2
No. 2 CWAD	14.9	15.7	14.0	15.6	14.7	15.1
No. 3 CWAD	14.5	15.5	14.1	14.7	14.5	14.6
No. 4 CWAD	13.9	15.2	13.5	13.8	13.9	13.5
All Grades	**14.7**	**15.6**	**14.0**	**15.3**	**14.6**	**14.9**

* N x 5.7; 13.5% moisture content basis.

14: NO. 1 AND NO. 2 CANADA WESTERN AMBER DURUM WHEAT
Quality Data for 1989 Harvest Survey Grade Composite Samples

Quality Parameter	1989		1988	
	No. 1 CWAD	No. 2 CWAD	No. 1 CWAD	No. 2 CWAD
WHEAT				
Test Weight, kg/hL	81.0	79.9	81.5	80.4
Weight per 1000 Kernels, g	37.7	38.0	41.8	41.6
Vitreous Kernels, %	90	81	93	86
Protein Content, %	15.0	14.8	15.5	15.8
Ash Content, %	1.52	1.67	1.59	1.61
SDS Sedimentation, mL	45	44	42	44
Falling Number, s	430	320	410	370
Milling Yield, %	75.5	75.7	74.9	75.1
Semolina Yield, %	65.7	65.5	63.6	63.3
SEMOLINA				
Protein Content, %	14.3	14.3	14.6	14.8
Wet Gluten Content, %	36.9	37.6	38.6	40.6
Ash Content, %	0.71	0.71	0.66	0.68
AGTRON Color, units	67	67	68	69
Speck Count per 50 cm^2	14	19	14	21
SPAGHETTI				
Dried at 39°C				
Color:				
Brightness, %	49.0	48.6	46.1	46.2
Purity, %	52.1	51.3	54.7	54.5
Dominant Wavelength, nm	577.0	577.0	577.4	577.4
Cooking Quality, CQP	46.7	44.0	29.9	31.6
Stickiness, N/m^2	1110	1080	580	540
Cooking Loss, %	6.5	6.3	6.5	6.3
Dried at 70°C				
Color:				
Brightness, %	47.8	48.0	47.3	47.4
Purity, %	51.4	50.7	55.1	54.8
Dominant Wavelength, nm	577.3	577.2	577.7	577.7
Cooking Quality, CQP	57.3	48.4	53.7	50.4
Stickiness, N/m^2	670	720	590	480
Cooking Loss, %	5.4	5.0	5.2	5.1

15: NO. 3 AND NO. 4 CANADA WESTERN AMBER DURUM WHEAT
Quality Data for 1989 Harvest Survey Grade Composite Samples

Quality Parameter	1989		1988	
	No. 3 CWAD	No. 4 CWAD	No. 3 CWAD	No. 4 CWAD
WHEAT				
Test Weight, kg/hL	79.4	78.4	79.4	77.8
Weight per 1000 Kernels, g	39.6	39.8	42.7	42.1
Vitreous Kernels, %	62	48	68	55
Protein Content, %	14.6	13.9	15.4	15.2
Ash Content, %	1.60	1.57	1.66	1.65
SDS Sedimentation, mL	40	40	42	44
Falling Number, s	220	125	270	160
Milling Yield, %	75.9	75.1	74.3	74.1
Semolina Yield, %	65.4	64.9	63.2	62.9
SEMOLINA				
Protein Content, %	13.9	13.2	14.7	14.3
Wet Gluten Content, %	36.9	34.6	40.1	39.5
Ash Content, %	0.72	0.70	0.69	0.69
AGTRON Color, units	68	68	65	65
Speck Count per 50 cm^2	24	26	31	40
SPAGHETTI				
Dried at 39°C				
Color:				
Brightness, %	48.7	49.0	45.8	45.0
Purity, %	50.4	50.9	54.7	53.3
Dominant Wavelength, nm	577.0	576.9	577.4	577.5
Cooking Quality, CQP	41.2	32.6	31.8	24.8
Stickiness, N/m^2	1070	1040	560	600
Cooking Loss, %	6.6	6.5	6.6	7.0
Dried at 70°C				
Color:				
Brightness, %	48.7	49.0	45.7	45.6
Purity, %	50.2	50.4	53.9	53.0
Dominant Wavelength, nm	577.1	577.0	577.8	577.9
Cooking Quality, CQP	61.5	46.8	55.9	43.4
Stickiness, N/m^2	710	770	520	550
Cooking Loss, %	5.5	5.3	5.3	5.5

Canada Western Red Winter Wheat

Canada Western Red Winter (CWRW) wheat has excellent milling quality. Flour produced from high grade CWRW wheat performs well in the production of hearth breads and certain types of noodles, and is also suitable for the production of various types of flat bread, steamed bread and related products.

Production for 1989 is estimated by Statistics Canada (*Field Crop Reporting Series*, No. 7, October 4, 1989) at 223 thousand tonnes, down 14.5% from last year due to overwintering damage to the plants and a decrease in seeded area. The variety Norstar accounts for 95% of the area seeded to CWRW wheat and Norwin for 4% (*Prairie Grain Variety Survey 1989*, Prairie Pools Inc., Regina).

As indicated in Table 16, the average protein content of 11.3% (13.5% moisture basis) for this year's crop is 1.4 percentage units lower than last year's. The 1989 harvest survey included 397 samples. The No. 1 grade shows the highest protein content (12.0%) of the three milling grades.

Quality data of composites representing the top three grades of CWRW wheat, as well as comparative data for the 1988 composites of the No. 1 and No. 2 CW grades, are given in Table 17. Test weight of the No. 1 grade is lower and that of the No. 2 grade is higher than corresponding 1988 values. Kernel weight for both grades is higher than last year. The high wheat falling number and flour amylograph peak viscosity values are consistent with the low levels of alpha-amylase activity obtained for both composites.

Both the No. 1 and No. 2 grades show excellent overall milling quality with high flour yield and very low flour ash and flour color values. This year's crop shows weaker dough properties (shorter farinograph dough development time and lower extensigraph area) compared with 1988 results. Farinograph and baking absorption are also lower than last year. These reductions in dough strength properties and absorption can be attributed to the lower protein content of the 1989 crop. As usual, high loaf volume per unit protein content is obtained with the Remix baking procedure.

16: Protein Content of 1989 Harvest Survey Canada Western Red Winter Wheat

	Protein Content (%)*				
	Western Canada		1989		
Grade	1989	1988	Manitoba	Saskatchewan	Alberta
No. 1 CWRW	12.0	13.2	12.4	12.2	11.8
No. 2 CWRW	10.2	12.5	10.6	10.3	9.9
No. 3 CWRW	9.7	11.8	9.3	9.9	9.7
CW Feed	11.4	11.5	-	-	11.4
All Grades	**11.3**	**12.7**	**11.6**	**11.5**	**11.1**

* N x 5.7; 13.5% moisture content basis.

17: CANADA WESTERN RED WINTER WHEAT
Quality Data for 1989 Harvest Survey Grade Composite Samples

Quality Parameter	1989			1988	
	No. 1 CW	No. 2 CW	No. 3 CW	No. 1 CW	No. 2 CW
WHEAT					
Test Weight, kg/hL	82.1	82.1	81.0	82.9	81.4
Weight per 1000 Kernels, g	30.1	30.6	32.7	29.5	29.4
Protein Content, % (N x 5.7)	11.9	10.5	9.9	13.1	12.6
Ash Content, %	1.44	1.52	1.48	1.39	1.42
Alpha-amylase Activity, units/g	4.4	7.9	87.6	15.5	27.1
Falling Number, s	360	350	180	325	280
Flour Yield, %	75.8	76.1	76.2	76.4	75.6
FLOUR					
Protein Content, %	11.2	9.8	9.1	12.2	11.7
Wet Gluten Content, %	31.7	27.1	24.7	38.3	35.8
Ash Content, %	0.44	0.45	0.43	0.42	0.43
Color, units	-1.4	-1.8	-2.1	-1.1	-0.8
Starch Damage, Farrand units	22	23	21	19	20
Alpha-amylase Activity, units/g	1.7	2.4	32.7	3.8	7.3
Amylograph Peak Viscosity, BU	600	545	80	450	235
Maltose Value, g/100 g	1.8	1.7	2.9	1.8	2.1
BAKING (Remix Method)					
Absorption, %	58	54	53	61	60
Loaf Volume, cm^3	795	685	660	855	805
Appearance	8.5	7.8	7.8	8.5	8.2
Crumb Structure	7.0-o	6.5	6.5	7.0-o	6.8-o
Crumb Color	5.8-d	5.2-d	5.5-d	7.0	7.0
FARINOGRAM					
Absorption, %	57.0	55.2	53.8	58.6	58.2
Development Time, min.	5.75	4.00	1.50	6.25	5.25
Mixing Tolerance Index, BU	45	35	40	50	50
Stability, min.	10.00	8.50	5.50	8.50	7.50
EXTENSIGRAM					
Length, cm	21	22	22	24	25
Height at 5 cm, BU	305	295	260	270	280
Maximum Height, BU	560	490	430	525	525
Area, cm^2	150	145	130	165	170
ALVEOGRAM					
Length, mm	161	156	122	197	186
P (height x 1.1), mm	57	52	45	51	52
W, x 10^3 ergs	294	259	191	310	298

Canada Western Soft White Spring Wheat

Canada Western Soft White Spring (CWSWS) wheat is a lower protein, soft wheat with weak dough properties. Flours milled from this wheat are suitable for the production of cookies, cakes, biscuits and related products. They can also be used alone or in blends with stronger wheat flours for the production of certain types of noodles and flat breads.

The Alberta Wheat Pool estimates this year's production of CWSWS wheat to be 308 thousand tonnes - up from last year's production of 271 thousand tonnes. Fielder (92% of the area seeded to CWSWS wheat) and Owens (7%) are again the major varieties grown (*Prairie Grain Variety Survey 1989*, Prairie Pools Inc., Regina).

Table 18 gives protein data for the 1989 harvest survey (based on 210 samples) and corresponding data from the 1988 and 1987 surveys. The protein content of this year's crop, as in 1988, shows higher values than normally expected for CWSWS wheat. Values for all three grades are similar to those from 1988.

Quality data for the top two grade composites and comparative results from last year's survey are given in Table 19. Test weight and kernel weight values are lower than in 1988. Wheat falling number and flour amylograph peak viscosity values for both grades are also lower than last year, indicating higher levels of alpha-amylase activity.

Milling results show superior flour yield but inferior flour color compared with 1988 results. Physical dough properties appear somewhat weaker than in 1988, as indicated by the shorter farinograph dough development time of the No. 1 grade and the lower alveograph values for both grades.

18: Protein Content of 1989 Harvest Survey Canada Western Soft White Spring Wheat

	Protein Content (%)*		
Grade	1989	1988	1987
No. 1 CWSWS	10.9	11.0	10.0
No. 2 CWSWS	11.0	11.5	10.4
No. 3 CWSWS	11.2	11.4	10.5
CW Feed	11.1	10.8	10.4
All Grades	**11.0**	**11.1**	**10.3**

* N x 5.7; 13.5% moisture content basis.

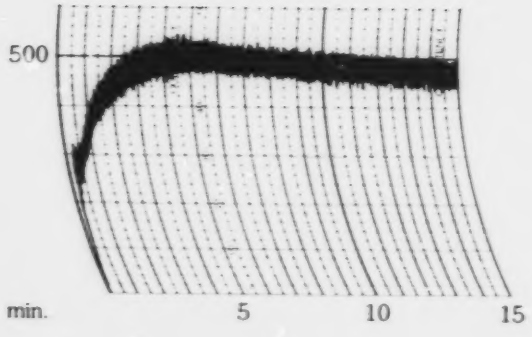
19: CANADA WESTERN SOFT WHITE SPRING WHEAT
Quality Data for 1989 Harvest Survey Grade Composite Samples

Quality Parameter	1989		1988	
	No. 1 CWSWS	No. 2 CWSWS	No. 1 CWSWS	No. 2 CWSWS
WHEAT				
Test Weight, kg/hL	80.5	79.8	82.3	81.5
Weight per 1000 Kernels, g	34.7	35.7	38.1	36.4
Protein Content, % (N x 5.7)	11.0	11.0	11.2	11.5
Ash Content, %	1.51	1.48	1.47	1.55
Alpha-amylase Activity, units/g	19.7	65.3	4.8	6.7
Falling Number, s	280	165	360	330
Flour Yield, %	72.2	73.5	71.8	69.7
FLOUR				
Protein Content, %	9.6	9.6	9.6	10.0
Wet Gluten Content, %	32.2	37.1	33.4	33.4
Ash Content, %	0.41	0.42	0.42	0.40
Color, units	-0.5	0.4	-1.1	-0.8
Starch Damage, Farrand units	8	8	7	5
Alpha-amylase Activity, units/g	7.9	24.2	1.6	2.0
Amylograph Peak Viscosity, BU	525	170	985	895
Maltose Value, g/100 g	1.1	1.5	1.0	1.0
FARINOGRAM				
Absorption, %	54.4	54.5	55.6	55.2
Development Time, min.	1.25	1.25	1.75	1.00
Mixing Tolerance Index, BU	170	180	175	160
Stability, min.	1.25	1.50	1.50	1.50
ALVEOGRAM				
Length, mm	170	173	156	189
P (height x 1.1), mm	25	23	25	23
W, x 10^3 ergs	55	50	60	63

Figure 6: Farinograms of 1989 Crop Composite Samples

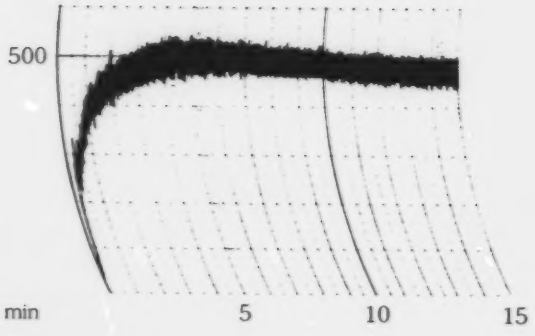
No. 1 Canada Western 14.5 Red Spring Wheat

Eastern Prairie



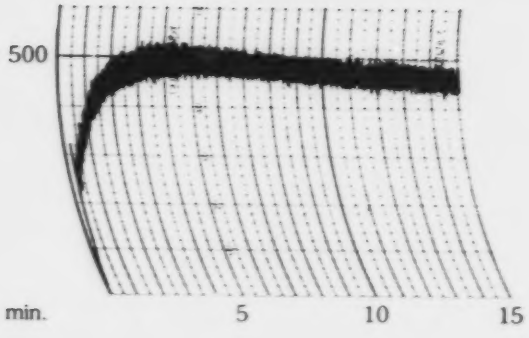
No. 1 Canada Western 14.5 Red Spring Wheat

Western Prairie



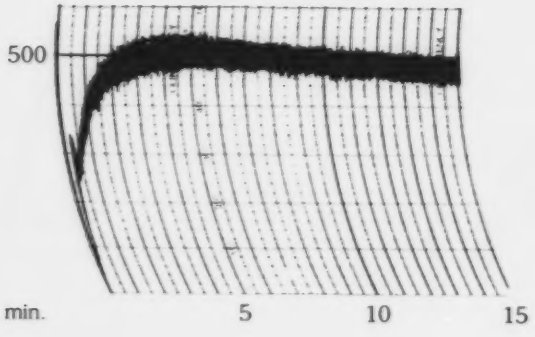
No. 1 Canada Western 13.5 Red Spring Wheat

Eastern Prairie

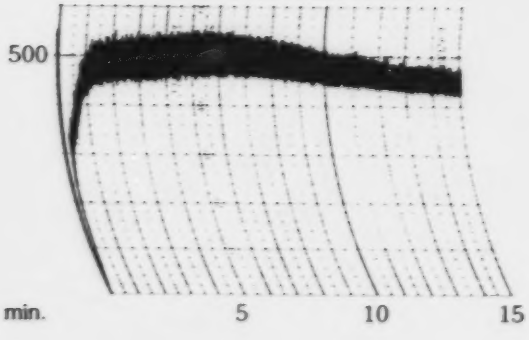


No. 1 Canada Western 13.5 Red Spring Wheat

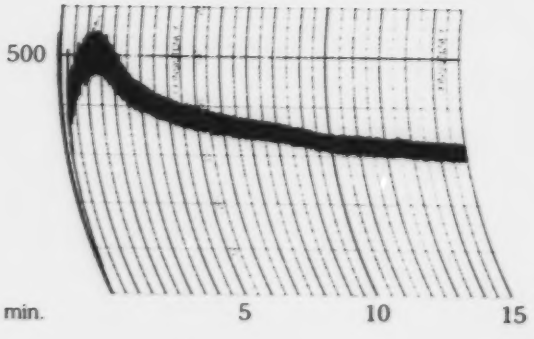
Western Prairie



No. 1 Canada Western Red Winter Wheat



No. 1 Canada Western Soft White Spring Wheat



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Methods

Notes on the methods used at the Grain Research Laboratory are given below. Unless otherwise specified, analytical results for wheat are reported on a 13.5% moisture basis and for flour on a 14.0% moisture basis. The AACC methods cited are those of the American Association of Cereal Chemists given in *Cereal Laboratory Methods*, Eighth Edition, 1983. The ICC methods are those of the International Association for Cereal Science and Technology.

Test Weight is determined using the Schopper Chondrometer equipped with the 1 litre container. The weight in grams of the measured litre of wheat is divided by 10 and the result is reported on an "as is" moisture content basis.

Weight per Thousand Kernels. Broken kernels and foreign material are first removed from a sample by hand-picking. The number of kernels in a 20 g sub-sample of this cleaned material is then counted using an electronic seed counter.

Protein Content (N x 5.7) is determined by the Kjeldahl method as modified by Williams, "Journal of the Science of Food and Agriculture" 24:343, 1973.

Alpha-amylase Activity of wheat and of flour is determined by the method of Kruger and Tipples, "Cereal Chemistry" 58:271-274, 1981.

Falling Number is determined on a 7 g sample of ground wheat by the method of Hagberg, "Cereal Chemistry" 38:202-203, 1961. Wheat (300 g) is ground in a Falling Number Laboratory Mill 3100 (ICC Standard Method No. 107). Results are reported on a 14.0% moisture content basis.

Milling (flour) is carried out in an Allis-Chalmers laboratory mill using the GRL sifter flow as described by Black *et al*, "Cereal Foods World" 25:757-760, 1980.

Pilot Milling (flour) is carried out as described by Black, "Bulletin - Association of Operative Millers", 2957 - 2958, 1980.

Wet Gluten Content. The ICC Standard Method No. 137 is followed using the "Glutamatic" System.

Ash Content is determined on a 4 g sample in a silica dish incinerated overnight at 600°C. After cooling, the dish plus ash are weighed, the ash brushed out, the dish reweighed, and the weight of ash determined by difference.

Flour Color. A color index is obtained using the automated Simon Series IV Flour Color Grader which gives the relative reflectance of a flour-water slurry. Results are reported as arbitrary scale units; the lower the number, the brighter the color.

Starch Damage is determined on a 5 g sample by the method of Farrand, "Cereal Chemistry" 41:98-111, 1964.

Amylogram. Sixty-five grams of flour (14.0% moisture content basis) and 450 mL distilled water are used with the Brabender Amylograph and the pin stirrer; other details are as in AACC Method 22-10. Peak viscosity is reported in Brabender units.

Maltose Value is determined according to AACC Method 22-16.

Baking is carried out by the Remix baking test procedure of Irvine and McMullan, "Cereal Chemistry" 37:603-613, 1960, as described in detail by Kilborn and Tipples, "Cereal Foods World" 26:624-628, 1981.

Farinogram. Fifty grams of flour (14.0% moisture content basis) are mixed in a small stainless steel farinograph bowl (63 r.p.m. drive) for 15 min. with sufficient distilled water to give a maximum dough consistency centered about the 500 Brabender Unit line. Farinograph absortpion is the amount of water which must be added to a flour of 14.0% moisture content to give the required consistency, and is reported as percent. Dough development time is the time required for the curve to reach its maximum height. For additional details, see the *Farinograph Handbook*, AACC, 1960.

Extensigram. Doughs are made from 300 g flour (14.0% moisture content basis), 6 g salt, and distilled water equal to the farinograph absorption less 2.0 percentge units to compensate both for the salt and for the substitution of the large stainless steel farinograph bowl. Doughs are mixed for 1 min., rested for 5 min., and mixing is then continued until the curve is centered about the 500 Brabender Unit line. Curves are drawn for duplicate doughs at 45 and at 135 min. though doughs are also rounded and shaped at 90 min. Average curves for 45 and 135 min. are reproduced, but measurements (length in centimeters, height in Brabender Units, and area in square centimeters) are reported only for the 135 min. curve (solid line). The Extensigraph is set so that 100 Brabender Units equal a 100 g load.

Alveogram. The ICC Standard Method No. 121 is followed, using the constant pressure Model MA82 instrument.

Supplementary Baking Tests. The Sponge-and Dough method (4.5 hr. 70% sponge) is carried out as described by Kilborn and Preston, "Cereal Chemistry" 58:198-210, 1981. The Canadian Short Process method is carried out as described by Preston *et al*, "Canadian Institiute of Food Science and Technology Journal" 15:29-36, 1982. For both methods loaves are produced from 200 g of flour in baking pans that have cross-section dimensions similar to those of Canadian commercial baking pans. Preliminary baking tests are carried out to determine optimum oxidation requirements.

Vitreous Kernels. This determination is made by the Grain Inspection Division on a 25 g sample of clean wheat. The vitreous kernels are handpicked and weighed.

SDS Sedimentation values are determined by the method of Axford and Redman, "Cereal Chemistry" 56:582 (1979), using 3% SDS.

Milling (semolina). Wheat is cleaned, scoured and tempered overnight to 16.5% moisture prior to milling by a modified Buhler Laboratory Mill (Black and Bushuk, "Cereal Science Today" 12:164, 1967) in conjunction with a laboratory purifier (Black, "Cereal Science Today" 11:533, 1966). The mill flow described by Dexter *et al*("Canadian Institute of Food Science and Technology Journal" 15:225, 1982) was lengthened to achieve a higher extraction. Milling yield (including flour) and semolina yield (less than 1% through a 149 micron sieve) are reported, on a constant moisture basis, as a percentage of the cleaned tempered wheat. The millroom is controlled for temperature (22°C) and humidity (60%).

Semolina Color is determined according to AACC Method 14-30. An AGTRON direct reading reflectance spectrophotometer is used.

Speck Count is determined as described by Dexter and Matsuo, "Cereal Chemistry" 59:63 (1982).

Spaghetti is processed from semolina on a DEMACO laboratory-scale continuous extrusion press as described by Matsuo *et al* "Cereal Chemistry" 55:744 (1978) and dried both by a conventional low-temperature drying cycle (39°C) and by a high-temperature cycle (70°C) as described by Dexter *et al* "Journal of Food Science" 46:1741 (1981).

Spaghetti Color. Whole strands of spaghetti are mounted on white cardboard for color measurements. Dominant wavelength, purity and brightness are determined, using the Ten Selected Ordinates method, with a Beckman DU-7 Spectrophotometer.

Spaghetti Cooking Quality is determined according to the method of Dexter and Matsuo, "Canadian Journal of Plant Science" 57:717-727, 1977.

Stickiness of Cooked Spaghetti is measured on the GRL Compression Tester as described by Dexter *et al*, "Cereal Chemistry" 60:139, 1983.

Cooking Loss, the amount of material lost in the cooking water, is determined as described by Dexter and Matsuo, "Cereal Chemistry" 56:394, 1979.

Farinogram (semolina). Fifty grams of semolina (14.0% moisture content basis) is mixed with distilled water (31.5% absorption) in the small stainless steel farinograph bowl (59 r.p.m. drive), using the rear sensitivity setting.

Collection of Samples. Samples are obtained from grain companies operating primary elevators in Western Canada. The grade composites of Red Spring Wheat are prepared by using samples from Manitoba and the eastern half of Saskatchewan for the Eastern Prairie composites and from Alberta and the western half of Saskatchewan for the Western prairie composites. Samples collected up to and including the following dates were used:

September 14	- No. 1 CW Amber Durum Wheat
September 20	- No. 1 CW Red Spring Wheat • Eastern Prairie - No. 1 CW, No. 2 CW, and No. 3 CW Red Winter Wheat
September 26	- No. 2 CW Amber Durum Wheat
September 27	- No. 2 CW Red Spring Wheat • Eastern Prairie
October 4	- No. 1 CW Red Spring Wheat • Western Prairie
October 10	- No. 3 CW and No. 4 CW Amber Durum Wheat
October 11	- No. 2 CW Red Spring Wheat • Western Prairie
October 13	- No. 3 CW Red Spring Wheat • Eastern and Western Prairie - No. 1 and No. 2 CW Soft White Spring Wheat

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